10/537542

METHOD FOR CONTROLLING AFTER-RUN IN FILLING UNITS

The invention relates to a method for controlling the amount of after-run in filling units, as such method is defined in the preamble of claim 1.

Filling units are used in many areas of the foods and pharmaceuticals industries, in order to fill a defined amount of a medium into a containment. An essential requirement of these filling units is that they must maintain a constant fill amount, and this in the face of filling times becoming ever increasingly shorter.

In the case of high-performance beverage filling units, up to 65,000 bottles per hour can be filled. In such case, the precision and reproducibility of a single filling is a significant quality feature. Each overfilling or underfilling means a financial loss for the unit operator. In particular, legal requirements concerning deviations from the specified amount must also be met.

The filled amount of the medium is controlled by means of a metering valve. To this end, the metering valve is, in turn, controlled by a control unit. At a given point in time, the metering valve is opened, and the medium can flow into the container, until the metering valve is again closed at a later point in time. The amount of the medium is determined by means of a flow meter. For this, there are two different variants, volume flow meters and mass flow meters. In the case of the volume flow measuring device, it can be, for example, a Promag 50 or a Dosimag 2. As mass flow devices, for example, a Promass 83 or a Dosimass 2 can be used. Both previously-named device types are sold by the firm Endress + Hauser.

An important aspect to consider in the case of filling units is the after-run amount. The after-run amount is that amount of the medium that continues to flow after the metering valve has

received the command "close metering valve." The reason for this is that the metering valve does not close instantaneously, but rather has a certain closing time.

For the control unit, this means that the close command cannot first be generated when the flow rate meter has registered the desired amount of the product, but rather already at an earlier point in time. The control unit must generate the close command for the metering valve at exactly that point in time at which the just-measured flow rate amount, plus the stored after-run amount, equals the specified amount of medium.

The exact after-run amount for a single filling can be directly measured only complexly; it is also dependent on a number of factors.

When the close command for the metering valve is generated by the control unit too early, the filled amount of product is then below the specified amount, and the close command must, therefore, be adjusted to come later. In the opposite case, when the close command comes too late, too much of the medium flows into the container, and the close command must be adjusted to come earlier.

The control determining the exact point in time for the close command of the metering valve is called after-run amount control. The after-run amount is established over multiple filling instances. If the average value of a single filling lies above the specified amount, then the duration of the opening of the metering valve must be shortened. The more filling instances that are taken into consideration, the more precisely the point in time for the close order can be determined.

A problem here is that the after-run amount depends on the process conditions, and can thus vary over time. Especially after a machine stoppage, the after-run amount can change greatly.

An object of the invention, therefore, is to provide a method for controlling after-run amount in filling systems, which method, even in the case of changes in the filling conditions, enables a precise metering of the amount of product to be filled.

This object is achieved by the method defined in claim 1.

An essential idea of the invention is that, after a change in filling conditions, the after-run amount is determined via the averaging of fewer filling instances than during normal operation.
Advantageous further developments of the invention are defined in the dependent claims.

A change in filling conditions can exist when a machine-stop, or machine-start, signal is present.

In normal operation, the averaging advantageously occurs over n >= 3 filling instances. After a change in filling conditions, the averaging advantageously occurs over m >= 1 filling instances. Advantageously, the number of averagings m is dynamically increased from 1 to n following a change in filling conditions.

In accordance with a further development of the invention, a change in filling conditions is signaled when the time span between two filling instances is greater than a predetermined limit value.

The invention will now be described in greater detail on the basis of an example of an embodiment illustrated in the drawings, the figures of which show as follows:

Fig. 1 schematic illustration of a filling unit; and

Fig. 2 schematic illustration of a filling curve, as a function of time.

Fig. 1 is a schematic illustration of a filling unit, in which a flowable medium is transported from a containment B1 to a containment B2 via a supply line 10. Arranged in the supply line 10 are a pump 1, a flow meter 3, and a metering valve 4. The flow meter 3 is connected to a control unit 20 via a signal line L1. The metering valve 4 is controlled by the control unit 20 via a signal line L2.

In the case of high-performance filling units in the beverage industry, the container B2 can be e.g. a beverage bottle. The length of a filling instance in the case of high-performance beverage filling units can be around 1 second.

Fig. 2 shows a typical filling curve. Flow rate is plotted as a function of time. The circled numbers in the drawing indicate the points in time for the following process events: 1. Command open metering valve; 2. metering valve is open; 3. close metering valve; and 4. metering valve is closed. The amount of product filled into the containment B2 corresponds to the area under the curve between points in time 1 and 4. As is clearly apparent from Fig. 2, the command, close metering valve, must be generated by the control unit 20 before the flow rate meter 3 has registered the desired amount of product. The amount of product which flows into the container B2 between points 3 and 4 is also called the after-run amount.

A conventional method for controlling after-run amount will now be described in greater detail. The after-run amount for a single filling is determined via the averaging of n filling instances. This averaging is carried out by the control unit 20. On the basis of the precise determination of the after-run amount, the point in time at which the command, close metering valve, is issued can be accurately determined in the control unit 20. Even after a change in the filling conditions, in this method, averaging is still performed over n filling instances.

The method of the invention will now be explained on the basis

of an example, in which, during normal measuring operation of the filling unit, the after-run amount is determined over n = 10 filling instances. Following a machine-stop or machine-start signal, the number of averagings m is reduced, compared to the number n in the normal operating condition. In the present case, m corresponds to the values 1 to 9. Because, following a machine start signal, the after-run amount slowly approaches a constant value asymptotically, the number of averagings is dynamically increased from 1 to n=10.

As a rule, changes in the filling conditions are indicated by a signal associated with the unit. Such a signal can be e.g. a machine-start, or machine-stop, signal. Sometimes in the case of filling units, no machine stop signal is generated. In this case, a machine stop can be assumed when the time span between two filling instances is longer than a predetermined limit value. Frequently, a machine-stop signal is also signaled via an external signal.

PATENT CLAIMS

1. Method for controlling after-run amount in a filling unit, in which the after-run amount is determined by the averaging of n filling instances, characterized in that, following a signal associated with the unit and signaling changes in the filling conditions, the after-run amount is determined by the averaging of m<n filling instances.

2. Method as claimed in claim 1, characterized in that the signal associated with the unit is a machine-stop, or machine-start, signal.

3. Method as claimed in claim 1 or 2, characterized in that n>=3.

4. Method as claimed in claim 3, characterized in that m>=1-3.

5. Method as claimed in one of the preceding claims, characterized in that, following a signal associated with the unit, m is increased dynamically from 1 to n.

6. Method as claimed in one of the preceding claims, characterized in that a machine stoppage is signaled when the time span between two filling instances is longer than a limit value.

7. Method as claimed in one of the preceding claims, characterized in that a machine-stop, or machine-start, signal is signaled via an external signal.

ABSTRACT

In a method for controlling after-run in a filling unit, wherein the amount of after-run is normally determined by the averaging of n filling instances, following a signal associated with the unit and signalling changes in the filling conditions, the after-run amount is determined by the averaging of m<n filling instances.

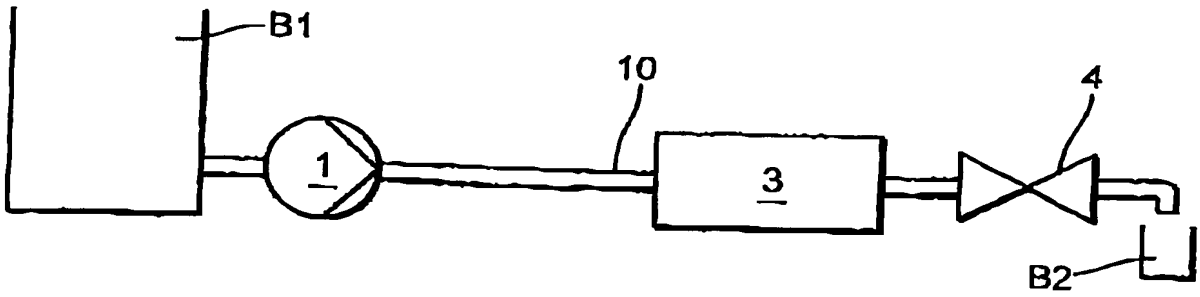

Fig. 1

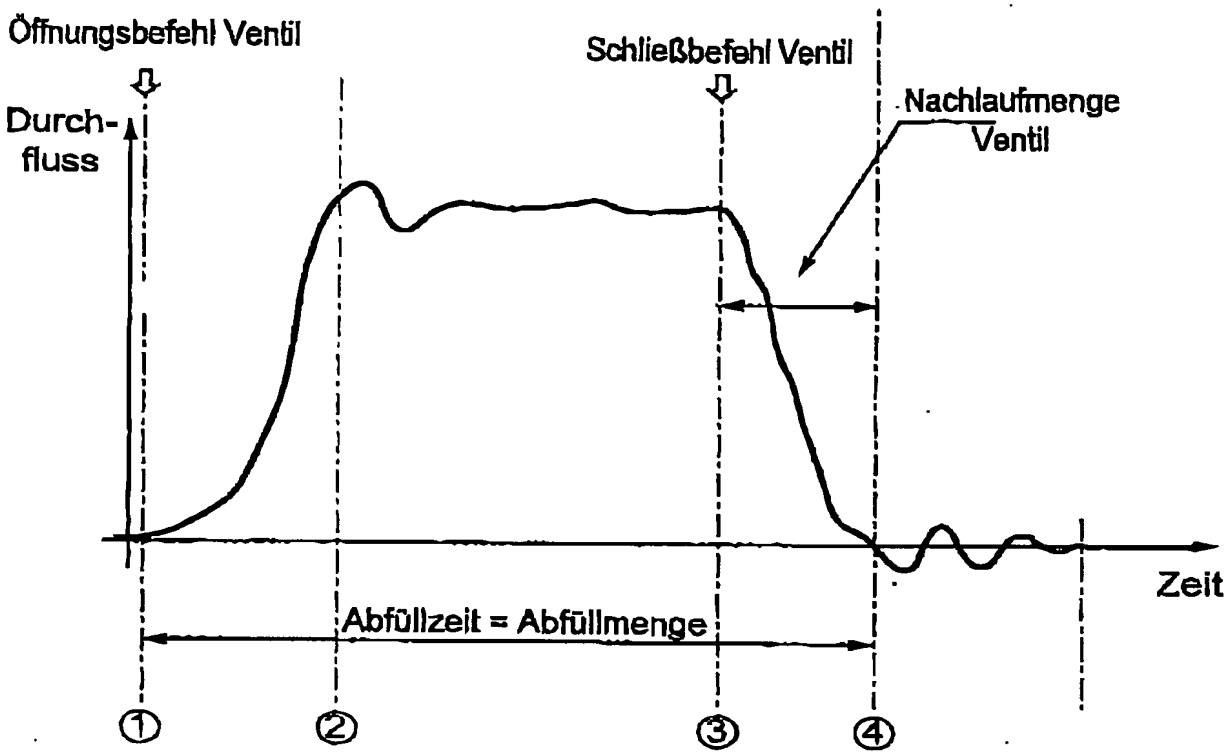
Öffnungsbefehl Ventil
Schließbefehl Ventil
Nachlaufmenge Ventil
Durch-fluss
Zeit
Abfüllzeit = Abfüllmenge
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Fig. 2

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	:	10/537,542
Confirmation No.	:	4804
Applicant	:	Breithaupt
Filed	:	June 3, 2005
Title	:	Method for controlling after-run in filling units
TC/A.U.	:	
Examiner	:	
Docket No.	:	BREI3003/FJD
Customer No.	:	23364

PRELIMINARY AMENDMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Introductory Comments

Please amend this application before examination on the merits in accordance with the following particulars.

Prior to calculation of the filing fee and examination of the application, please amend the claims as shown in the following LIST OF CURRENT CLAIMS, which indicates the status of all the claims in the application and all amendments to the claims. Any cancellation of claims is made without prejudice or disclaimer. Applicant reserves all rights to the original disclosed and claimed subject matter.

Amendments to the Specification appear on page 2 of this paper.
Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.
Amendments to the Drawings are noted on page 4 of this paper.

Amendments to the Specification:

On page 1, prior to the first paragraph which begins on line 2, please insert the following:

FIELD OF THE INVENTION

Please replace the paragraph which appears on page 1, lines 2 - 4, with the following rewritten paragraph:

The invention relates to a method for controlling the amount of after-run in filling units[[,]] ~~as such method is defined in the preamble of claim 1~~ in which the after-run amount is determined by the averaging of n filing instances.

Please replace the paragraph which appears on page 1, lines 5-10, with the following rewritten paragraph:

Background of the Invention

Filling units are used in many areas of the ~~foods~~ food and ~~pharmaceuticals~~ pharmaceutical industries, in order to fill a defined amount of a medium into a containment. An essential requirement of these filling units is that they must maintain a constant fill amount, and this in the face of filling times becoming ever increasingly shorter.

On page 3, prior to the first paragraph which begins on line 1, please insert the following:

SUMMARY OF THE INVENTION

Please replace the two paragraphs which appear on page 3, beginning at line 5 and ending at line 9, with the following rewritten paragraph:

This object is achieved by ~~the method defined in claim 1~~ determining the after-run amount by the averaging of m<m filling instances. ~~An~~ That is, an essential idea of the invention is that, after a change in filling conditions, the after-run amount is determined via the averaging of fewer filling instances than during normal operation.

On page 3, please delete lines 10 and 11.

On page 3, prior to the paragraph which begins on line 24, please insert the following:

BRIEF DESCRIPTION OF THE DRAWINGS

On page 4, prior to the paragraph which begins on line 1, please insert the following:

DESCRIPTION OF THE PREFERRED EMBODIMENT

Amendments to the Drawings

Two Replacement Drawings are attached.

Fig. 1 has been revised to include the control unit 20 and Lines 1 and 2.

Fig. 2 has been changed to include the English text instead of the German.

List of Current Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Claims 1 - 7 (Cancelled).

8. (New) A method for controlling after-run amount in a filling unit, comprising the steps of:

determining the averaging of n filling instances; and

following a signal associated with the unit and signaling changes in the filling conditions, the after-run amount is determined by the averaging of m<n filling instances.

9. (New) The method as claimed in claim 8, wherein:

the signal associated with the unit is a machine-stop, or machine-start, signal.

10. (New) The method as claimed in claim 8, wherein:

n>=3.

11. (New) The method as claimed in claim 10, wherein:

m>=1-3.

12. (New) The method as claimed in claim 8, wherein:

following a signal associated with the unit, m is increased dynamically from 1 to n.

13. (New) The method as claimed in claim 8, wherein:

a machine stoppage is signaled when the time span between two filling instances is longer than a limit value.

14. (New) The method as claimed in claim 8, wherein:

a machine-stop, or machine-start, signal is signaled via an external signal.

REMARKS

This amendment is made to better conform the specification and the claims to U.S. format. Applicant reserves all rights to the original claimed subject matter. None of the amendments are intended to narrow the scope of any of the original claims. Applicant reserves all rights to the original claimed subject matter.

Examination of the application as amended is respectfully requested.

Respectfully submitted,
BACON & THOMAS, PLLC

Date: March 31, 2006

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REPLACEMENT SHEET

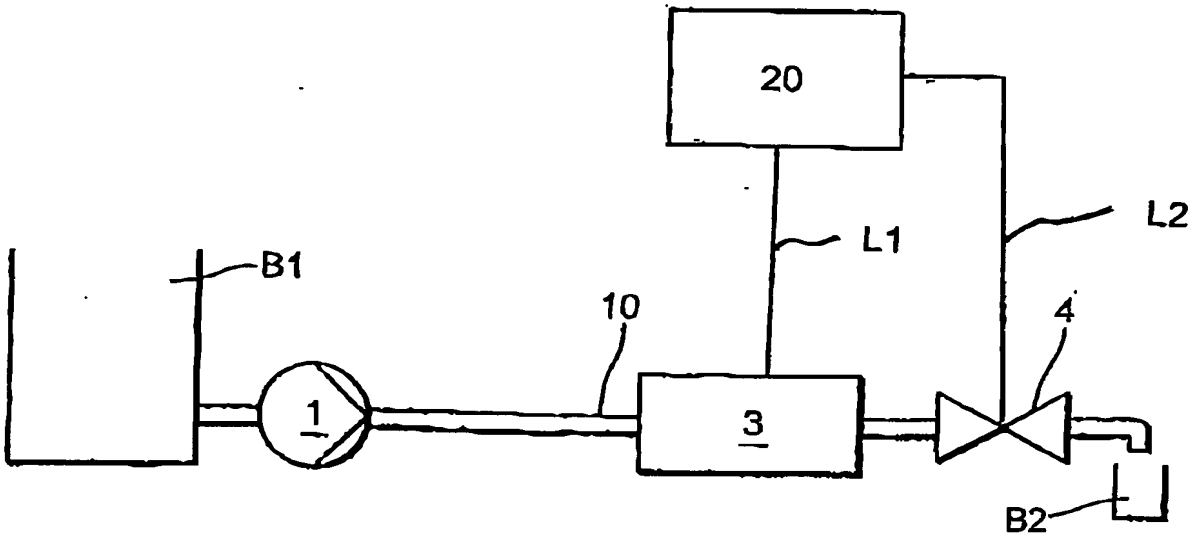

Fig. 1

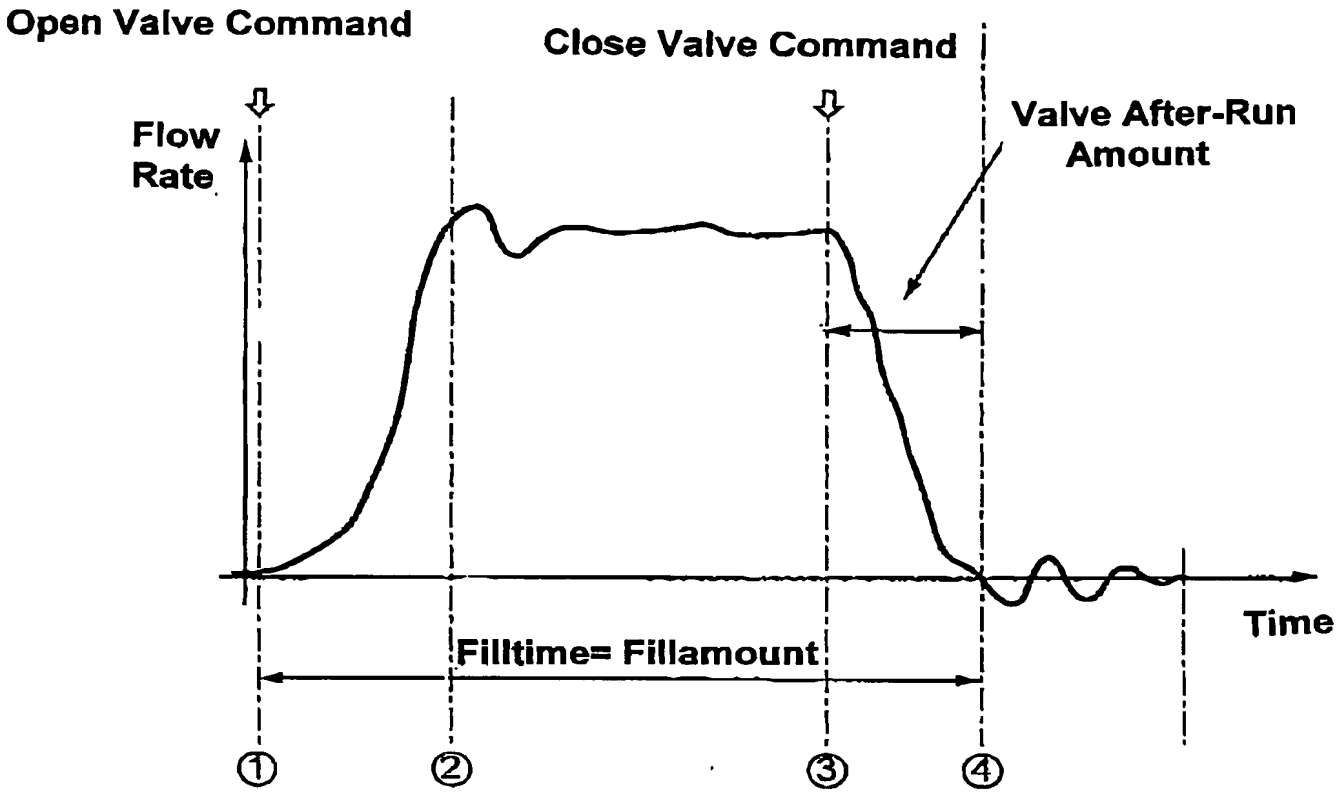
Open Valve Command
Close Valve Command
Flow Rate
Valve After-Run Amount
Time
Filltime= Fillamount
①
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Fig. 2